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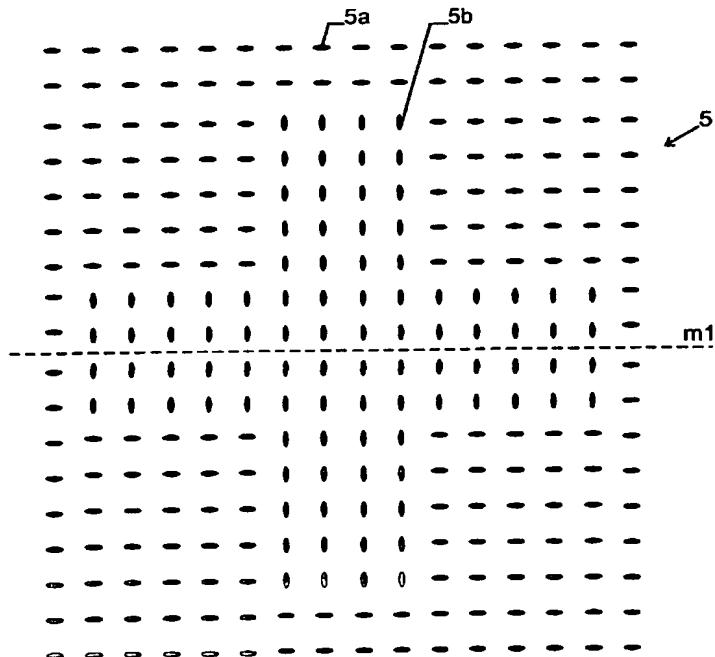
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(54) Title: SECURITY DOCUMENT AND VERIFICATION METHOD



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(57) Abstract: A security document, such as a banknote or a cheque, is provided with a perforation pattern (5) having holes (5a, 5b) with elongate cross section. When viewing the perforation pattern (5) from a direction that is non-perpendicular to the surface of the document, different holes will have different optical transmission, which can be verified by eye or electronically. Perforation patterns (5) of this type are hard to forge and easy to verify.

**Security document and verification method****Technical Field**

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The invention relates to a method for verifying the authenticity of a security document as well as to a security document having perforations of elongate cross section.

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**Background Art**

15 Fine perforations have been used successfully as a security feature for security documents, i.e. for documents the authenticity of which can be verified in a reasonably reliable manner, such as bank notes, passports or parts thereof, checks, etc.

20 WO 97/18092 describes a security document having a pattern of fine perforations that are visible when viewed in transmission while they are invisible when viewed in reflection. Even though this feature has found to be a very reliable means for authenticating the document, it is desired to increase the uniqueness of these and similar perforations in order to provide an even 25 higher degree of recognizability and reliability.

WO 00/43216 teaches, inter alia, to add perforations that extend obliquely through the document and that must be viewed under a given angle. However, manufacturing such oblique perforations is difficult and 30 their quality is likely to degrade over time, in particular when used for paper or thin plastic sheet documents that are subjected to frequent mechanical stress, such as bank notes.

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**Disclosure of the Invention**

Hence, it is an object of the present invention to provide a method and a document of the type men-

tioned above that further increases the reliability of this type of a security feature based on perforations.

This object is met by the method and document according to the independent claims.

5       The invention uses an effect that is observed with perforations having an elongate cross section. When such perforations are viewed from a direction that is non-perpendicular to the surface of the document, the transmission characteristics depend on the orientation of  
10      the viewing direction in respect to the directions of smallest and largest diameter of the cross section of the perforations. Hence, viewing the document from an direction as described above allows to determine the authenticity of the documents from the observed optical trans-  
15      mission of the perforations, e.g. by comparing the ob- served optical transmission to an expected optical trans- mission and rejecting the document as invalid if there is no match.

When viewing a perforation from a direction  
20      that is perpendicular to its minimum diameter, large transmission can be observed even if the angle between the viewing direction and the direction perpendicular to the document becomes large. On the other hand, when viewing a perforation from a direction that is perpendicular to its maximum diameter, the transmission is smaller.  
25      Hence, both these viewing directions are preferred viewing directions for a verification. Preferably, both viewing directions are used.

If the document comprises several perfora-  
30      tions with different cross sections, a single view along the viewing direction allows to observe differently ori- ented perforations with different expected optical trans- mission values, which further increases the reliability of the verification.

35      For obtaining very strong visual effects, the minimum diameter of the elongate perforations should sub-

stantially be equal to or smaller than the thickness of the document carrier.

5

#### Brief Description of the Drawings

The invention will be better understood and objects other than those set forth above will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings, wherein:

Fig. 1 shows a bank note having a security perforation pattern,

Fig. 2 shows the security perforation pattern in close view,

Fig. 3 shows a detail of the perforation pattern of Fig. 2,

Fig. 4 is a sectional view of the perforations of Fig. 3,

Fig. 5 is a detail of a second possible perforation pattern, and

Fig. 6 is a detail of a third perforation pattern.

25

#### Modes for Carrying Out the Invention

Fig. 1 shows a bank note having a carrier 1 of paper or plastic with conventional graphical and textual elements 2, 3, 4 and a security perforation pattern 5.

As shown in Fig. 2, security perforation pattern 5 comprises a plurality of perforations (holes) 5a, 5b extending through carrier 1. The perforations are arranged in a two-dimensional array. Preferably, they extend through the whole of carrier 1, but they may also

extend only partially therethrough as long as the optical transmission when viewed from a viewing direction perpendicular to the surface of carrier 1 is much larger at a perforation than at unperforated locations.

As can be seen from Fig. 2, which is a close-up of perforation pattern 5, two different types of holes are used.

A hole 5a and 5b, respectively, of each perforation type is shown in Fig. 3. In the shown embodiment, each hole 5a, 5b has elongate cross section and extends through carrier 1 in a direction perpendicular to the surface 1a of the same. The cross section is preferably substantially uniform through the carrier.

The cross sections of holes 5a and 5b in the embodiment of Figs. 3 and 4 are of equal elongate shape, but rotated in respect to each other by an angle of 90°. Each hole is of roughly ellipsoidal cross section having a minimum diameter  $d_1$  and  $d_1'$  and a maximum diameter  $d_2$  and  $d_2'$ , respectively. The minimum diameter  $d_1$  of hole 5a is substantially parallel to the maximum diameter  $d_2'$  of hole 5b and vice versa.

The minimum diameter  $d_1$  and  $d_1'$ , respectively, is preferably smaller or approximately equal to the thickness D of carrier 1 and may be in the range of 50  $\mu$  to 300  $\mu\text{m}$  for a bank note, preferably not more than 150  $\mu\text{m}$ . The maximum diameter may be substantially larger, e.g. at least 1.5 times larger than the minimum diameter.

The areas of the cross sections of the holes 5a, 5b are preferably equal. In that case, when the document is viewed against a light source in optical transmission from a viewing direction 7 that is perpendicular to surface 1a of carrier 1, the transmission of both types of holes is the same and the holes appear equally bright. However, when viewing from a viewing direction 7' that is not perpendicular to surface 1a, the amount light transmitted through the different types of holes 5a, 5b will generally be different because part of the light

will be blocked by the walls of the holes. For example, when viewing the document from direction 7' of Fig. 4, around 50% of the maximum amount of light will be transmitted through hole 5a while hole 5b will appear to be substantially blocked.

Generally, a high transmission will be observed when viewing the perforation pattern along a viewing direction that is perpendicular to the direction m<sub>1</sub> of minimum diameter d<sub>1</sub> while a low transmission will be observed if the viewing direction is perpendicular to the direction m<sub>2</sub> of maximum diameter d<sub>2</sub>.

This effect can be used for verifying the authenticity of the document by viewing it from at least one viewing direction that is non-perpendicular to surface 1a. The observed optical transmission of the perforations can e.g. be compared to an expected optical transmission from this viewing direction.

To simplify visual verification, it is preferred to provide carrier 1 with two types of perforations having differing cross sections, as shown in e.g. in Figs. 3, 5 or 6. When the document is viewed from a direction non-perpendicular to surface 1a, the perforations of the two groups will generally have differing optical transmission, which allows to check the feature by visually comparing the transmissions.

For example, when viewing perforation pattern 5 of Fig. 2 from a viewing direction perpendicular to direction m<sub>1</sub> and non-perpendicular to surface 1a, the perforations within the cross will generally be better visible than those outside it.

In the embodiment of Figs. 3 and 4, the two types of holes 5a, 5b have cross sections that are mutually rotated by 90°. In another embodiment, the holes have cross sections of different shape. Preferably, however, the areas of the cross sections of the different types of points are substantially equal such that the perforations have substantially uniform optical transmis-

sion when viewed along a viewing direction perpendicular to surface 1a. An example of two holes of such a perforation is shown in Fig. 5.

It is also possible to use a perforation pattern having more than two types of points with different cross sections for obtaining even more elaborate effects when viewing the document under an angle.

If the perforation pattern is to be inspected by a human, it is preferred to arrange the types of holes to form a human-recognizable pattern, such as the cross of Fig. 2.

The perforations of perforation pattern 5 are preferably manufactured by laser pulses. For producing a hole with elongate cross section, the beam from the laser can either be moved while applying the pulse or several separate pulses may be applied side by side in spatially overlapping manner.

The production of the perforation pattern is easiest when the dimension of all points is only varied in a single direction because this allows to use a single beam deflector to be operated during hole generation. This leads to a pattern where the minimum diameters of all holes are equal and parallel to each other.

A corresponding embodiment with elongate holes and circular holes is shown in Fig. 6. The first type of holes 5a has a minimum diameter  $d_1$  that is equal to both diameters  $d_1'$  of the second type of holes 5b.

Preparing a small perforation pattern as described above by purely mechanical means is, at best, difficult. In order to avoid ridges, drilling techniques would have to be used - it is, however, highly difficult to prepare an elongate hole of the type shown here by means of a mechanical drill. Therefore, using elongate holes makes the perforation pattern more difficult to forge using mechanical production techniques.

Furthermore, mechanically manufactured perforations have rougher edges and therefore increased light

scattering as compared to perforations generated by laser light.

In order to make a mechanical reproduction of the perforation pattern difficult, the minimum diameter 5  $d_1$ ,  $d_1'$  of the holes should preferably be 150  $\mu\text{m}$  or less.

In the embodiment shown here, the perforation pattern 5 was used in a banknote, but it may be used in other similar applications, such as in cheques or in the pages of a passport or other document that should be hard 10 to forge. Carrier 1 is preferably paper or a flexible plastic.

While there are shown and described presently preferred embodiments of the invention, it is to be distinctly understood that the invention is not limited 15 thereto but may be otherwise variously embodied and practiced within the scope of the following claims.

Claims

1. A method for verifying the authenticity of  
5 a document, wherein said document comprises a carrier (1)  
with a plurality of perforations (5a, 5b), wherein at  
least part of the perforations have an elongate cross  
section with a minimum and a maximum diameter (d<sub>1</sub>, d<sub>1'</sub>;  
d<sub>2</sub>, d<sub>2'</sub>), characterized by the step of viewing the docu-  
10 ment from at least one viewing direction (7') that is  
non-perpendicular to a surface (1a) of the carrier (1)  
and deriving the authenticity from an optical transmis-  
sion of said perforations (5a, 5b).

2. The method of claim 1 further comprising  
15 the step of comparing the optical transmission of said  
perforations (5a, 5b) with an expected optical transmis-  
sion.

3. The method of claim 2 wherein the document  
is viewed from at least one direction that is perpendicu-  
20 lar to a direction parallel to the maximum diameter (d<sub>2</sub>,  
d<sub>2'</sub>) of at least some of the perforations (5a, 5b).

4. The method of any of the preceding claims  
wherein the document is viewed from at least one direc-  
tion that is perpendicular to a direction parallel to the  
25 minimum diameter (d<sub>1</sub>, d<sub>1'</sub>) of at least some of the perfo-  
rations (5a, 5b).

5. The method of any of the preceding claims  
wherein said perforations (5a, 5b) extend through said  
carrier (1) in a direction perpendicular to said surface.

30 6. The method of any of the preceding claims  
wherein the minimum diameter (d<sub>1</sub>, d<sub>1'</sub>) is substantially  
equal to or smaller than a thickness (D) of the carrier  
(1).

7. A security document comprising carrier (1)  
35 and a security feature with a plurality of perforations  
(5a, 5b) in said carrier, in particular for carrying out  
the method of any of the preceding claims, wherein at

least part of the perforations (5a, 5b) have an elongate cross section with a minimum and a maximum diameter ( $d_1$ ,  $d_1'$ ;  $d_2$ ,  $d_2'$ ), characterized in that the document comprises at least two perforations (5a, 5b) with different 5 cross sections.

8. The security document of claim 7 wherein said perforations (5a, 5b) have cross sections with equal area but different shape.

9. The security document of any of the claims 10 7 or 8 wherein said plurality of perforations comprises a first type (5a) and a second type (5b) of perforations, wherein the minimum diameter ( $d_1$ ) of the first type of perforations is parallel to the maximum diameter ( $d_2'$ ) of the second type of perforations.

15 10. The security document of any of the claims 7 to 9 wherein said plurality of perforations (5a, 5b) have equal area of cross section and therefore uniform transmission when being viewed from a viewing direction perpendicular a surface of said carrier (1).

20 11. The security document of any of the claims 7 to 10 wherein said perforations (5a, 5b) form a human recognizable transmission pattern when viewed under an angle that is non-perpendicular to a surface of the carrier (1).

25 12. The security document of any of the claims 7 to 11 wherein said perforations (5a, 5b) extend through said document in a direction perpendicular to a surface (1a) of the carrier (1).

30 13. The security document of claim 12 wherein each perforation (5a, 5b) has substantially uniform cross section through said document.

35 14. The security document of any of the claims 7 to 13 wherein the carrier (1) is of flexible plastic or paper, and in particular wherein the security document is a banknote or part of a passport.

15. The security document of any of the claims 7 to 14 wherein some of said perforations (5a, 5b)

have circular cross section and/or are arranged in a two-dimensional array.

16. The security document of any of the claims 7 to 15 wherein the minimum diameter ( $d_1$ ,  $d_1'$ ) is 5 substantially equal to or smaller than a thickness (D) of the carrier (1).

17. The security pattern of any of the claims 7 to 16 wherein the minimum diameters ( $d_1$ ,  $d_1'$ ) of all perforations are equal, and in particular wherein all 10 minimum diameters ( $d_1$ ,  $d_1'$ ) of all perforations are parallel to each other.

18. The security pattern of any of the claims 7 to 17 wherein the maximum diameter ( $d_2$ ,  $d_2'$ ) is at least 1.5 times larger than the minimum diameter ( $d_1$ , 15  $d_1'$ ).

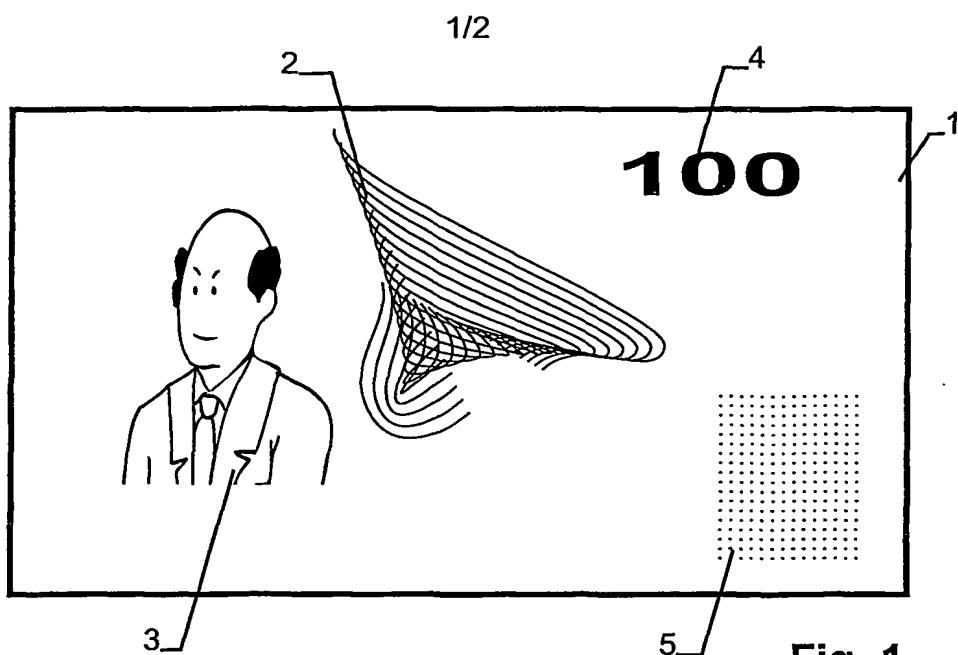


Fig. 1

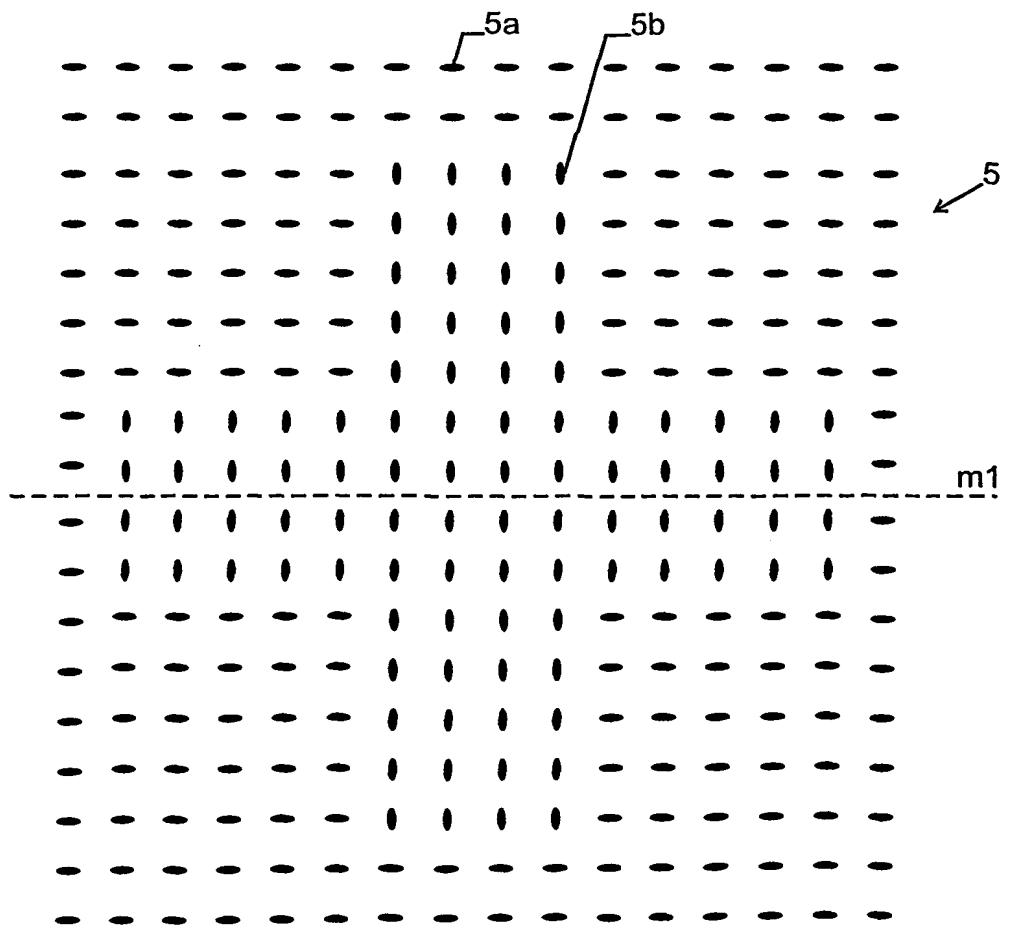
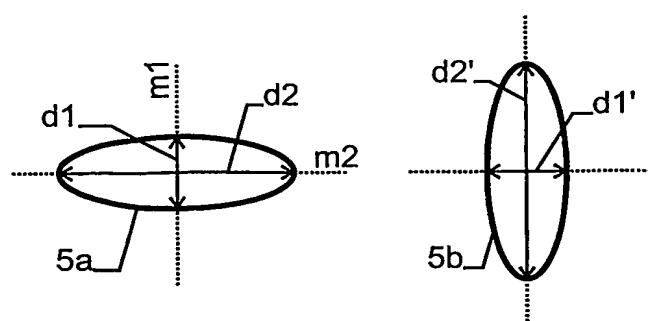
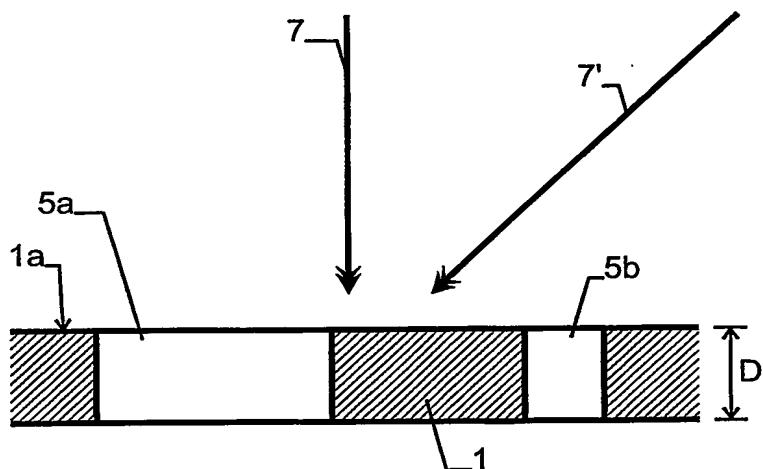
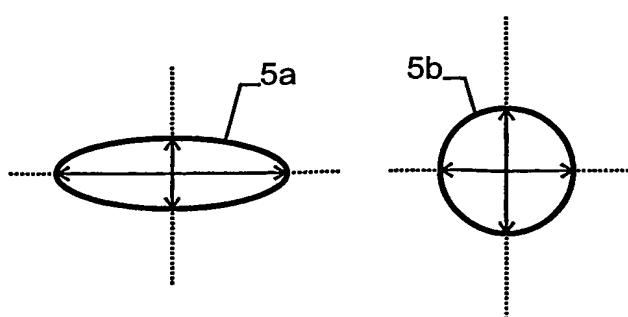
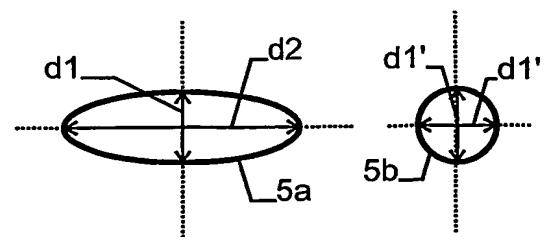


Fig. 2

2/2

**Fig. 3****Fig. 4****Fig. 5****Fig. 6**

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB02914

## A. CLASSIFICATION OF SUBJECT MATTER

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According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B42D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

WPI Data, EPO-Internal, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 00 43216 A (AUGUSTINUS ARNOUD ;IAI BV (NL); COBBEN JOHANNES IGNATIUS MARIE (NL) 27 July 2000 (2000-07-27) cited in the application the whole document ---	1
A	US 5 975 583 A (AUGUSTINUS ARNOUD ET AL) 2 November 1999 (1999-11-02) the whole document -----	1

 Further documents are listed in the continuation of box C. Patent family members are listed in annex.

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## INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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Patent document cited in search report		Application date	Patent family member(s)	Publication date
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